

Risk of Escaped Trash along U.S. Roadways

The Escaped Trash Risk Map models predicted litter densities along roadways in the U.S. for a snapshot in time. Escaped trash refers to litter that leaks out from waste management systems, whether through spillage from non-secured containers, intentional littering, or other means.

Highlights

- An estimated 10.3 billion litter items [8.7 – 12.2 billion] lie in areas adjacent to US roadways.
- 1.6 billion items [1.3 – 2.0 billion] are in areas with a 0.2% or 1% annual chance of flooding, making them at a higher risk to enter waterways.
- The mean litter density estimated along roadsides in the U.S. is 46.8 items per 100 m² transect [40.2 – 54.0 items].
- Based on citizen science data collected across all U.S. river basins between 2021 – 2023 (11,597,653 data points), 77% of litter items are estimated to be plastic, followed by 8% metal, 3% paper and lumber, and 3% glass.
- The top 10 litter items across the entire U.S. are: 1) plastic & foam fragments, 2) cigarettes/cigars, 3) plastic caps or lids, 4) plastic food wrappers, 5) plastic bottles, 6) plastic bags, 7) aluminum or tin cans, 8) straws, 9) foam or plastic cups or plates, and 10) metal bottle caps or tabs.
- The abundance of plastic bags and bottles in litter transect surveys is, on average, lower where policies (bans and deposit policies) are in place.

Study Methods

Litter survey methodology. Litter was surveyed using a random transect method at 315 sites within 52 cities across the U.S., distributed among the 20 U.S. river basins. In each city, sites (approximately 1 x 1 km each) were randomly selected after stratifying by ambient population count (societal activity over 24 hours from Oak Ridge National Laboratory LandScan data) across varied socioeconomic and land use environments. Within each site, litter was recorded in three randomly selected 100 m² transects adjacent to roadways. A total of 945 transects were surveyed, with at least six sites surveyed in each river basin.

Statistical model methodology. To understand how litter was distributed across the U.S., we designed a hierarchical mixed model using Bayesian inference. For this regression analysis, we assumed that litter counts observed along transects followed a negative binomial distribution with a log link function. In the linear equation of the model, the predictors of interest that correlated with litter density were the Human Development Index (HDI; a normalized index of income, education, and life expectancy) and a high proportion of developed, high-intensity land cover based on the National Land Cover Database. To understand the effect of these predictors on observed litter counts, we extracted the posterior distribution for each regression coefficient (for both population- and city-specific responses) and calculated their estimated mean and 95% credible interval. We then used the population-level mean parameter estimates to predict litter density in unobserved sites across the U.S. based on these risk factors. Litter counts were estimated within each river

basin based on the projected litter densities applied to the entire road length within each site in a 1-m swath on both sides of the road.

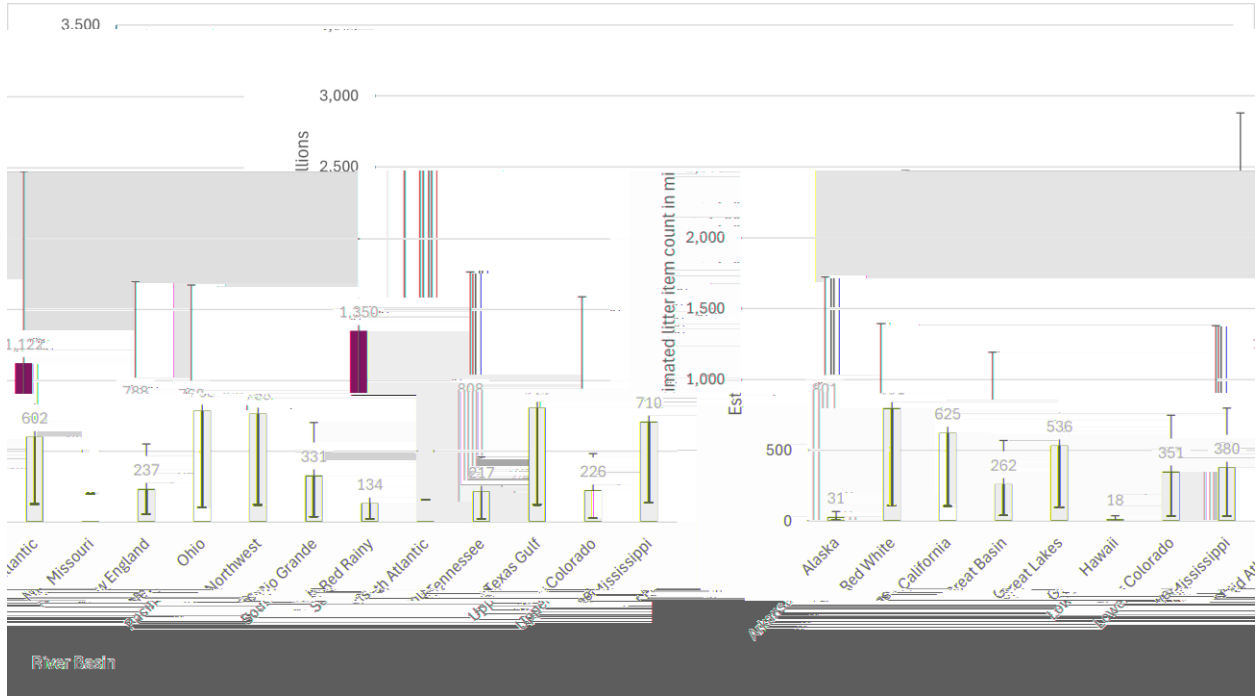
This analysis represents a snapshot in time. Extrapolation of litter density is only applied to areas accessible by road in the U.S. and does not distinguish by road type. The model does not attempt to quantify or characterize impacts from local activities such as illegal dumping, street sweeping, cleanup efforts, or regulations.

Litter characterization data. Data on more than 11.5 million debris items logged by citizen scientists from 2021 – 2023 was used to characterize litter by item count at the river basin level. Nearly 80% of the items logged were plastic, and the most common litter items were 1) plastic & foam fragments, 2) cigarettes/cigars, 3) plastic caps or lids, 4) plastic food wrappers, and 5) plastic bottles. Using the total estimated litter count for the U.S., these characterization data, and a database of average weights of marine debris from the University of Georgia, the total mass of litter in the U.S. is estimated to be 361,000 metric tons [305,000 to 427,000 metric tons]. Tires, which account for less than 0.5% of items logged, are much heavier than most common litter items. Excluding tires, the mass of litter is estimated to be 72,000 metric tons [61,000 to 85,000 metric tons].

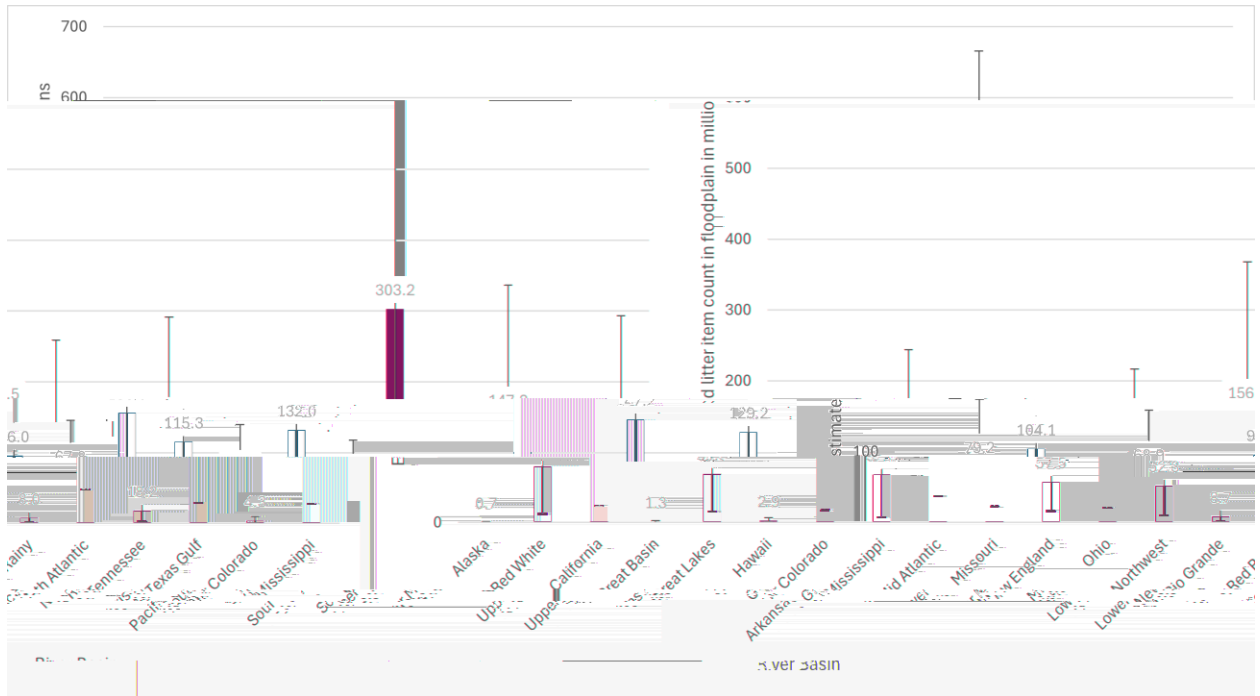
Microplastics in U.S. Waterways

We identified more than 65 studies of microplastic contamination in freshwater systems across the U.S. The methods used to collect and analyze water samples for microplastics varied greatly across studies, thus reported concentrations cannot be directly compared. Here, we report the proportion of samples in each study in which microparticles, either presumed or analytically confirmed to be plastic, were detected.

Estimate Total Litter Item Count by River Basin



Estimate Litter Item Count in Floodplain by River Basin



Acknowledgments

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¹ <https://voices.uchicago.edu/neilsheth/>